VEGETATIVE PROPAGATION OF WOODY SHRUB SPECIES FROM THE NORTHERN MOJAVE AND SOUTHERN GREAT BASIN DESERTS

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Some species of woody desert shrub species have been reported to be successfully propagated by means of stem cuttings. These include: *Fouquieria splendens* Engelm. (Shreve, 1951); *Chiliopsis linearis* Cav. (Everett, 1957; Charles, 1962); *Simmondsia chinesis* Link (Gentry, 1958); *Encelia farinosa* Gray, *Franseria dumosa* Gray, *Hymenoclea salsola* Torr. & Gray, *Peucephyllum schottii* (Gray) Gray, and *Pluchea sericea* (Nutt.) Cav. (Chase and Strain, 1966). Charles (1962) had only partial success with *Vauquelinia californía* (Torr.) Sarg. and *Garrya wrightii* Torr. Studies here reported extend the list of such plants which can be vegetatively propagated.

Attempts were made to vegetatively propagate materials from 17 woody perennials from the Nevada Test Site (northern Mojave—southern Great Basin deserts). Stem cuttings were collected in 1966, 1967, and 1968 brought to UCLA. A basic test pattern was established for which each species was subjected. From 5 to 15 cuttings of each of the species were subjected to 15 different treatments. The 15 treatments comprised a 3 $\times$ 5 factorial design. Three growth regulator treatments were a, control; b, dipping cut tips into Hormodin 2 (0.3% IBA in talc); c, and dipping into Hormodin 3 (0.8% IBA in talc preparations). They were then placed into vermiculite in wooden flats with screen bottoms. The cuttings with these three treatments were each placed into five different environmental conditions for rooting. The five were a, a mist house; b, a lathhouse; c, a glasshouse; d, a bottom-heated glasshouse which was open to outside air (low humidity); and e, a closed bottom-heated glasshouse (high humidity). Temperatures in these units reflected ambient conditions and varied from season to season, usually 20 to 30°C in the daytime and 10 to 20°C at night. Later studies involved placing the cuttings directly into Yolo loam soil before rooting. This proved to be a good technique for many species. Procedures selected from the above 15 test procedures except for use of soil are described below:

Larrea divaricata Cav. Stem cuttings taken from mature shoots in the field did not root, but many of those taken from seedlings did root. Within 3 years, however, these clones had decreased ability to root. The most successful technique involved the use of Hormodin 3 powder. Tips 7 to 15 cm in length were dipped in Hormodin 3 and placed in flats in a mist house. Rooting occurred in about a month but some cuttings rooted

and some did not. Precise control with air temperature of 15°C, root temperatures of 20°C and relative humidity of 90% with cuttings in Yolo loam soil has given most uniform results. Two clones representing two different ecotypes were selected for further propagation, and large populations of each have been produced.

Lycium andersonii Gray. Stem cuttings rooted easily, and no special kind of plant material seemed necessary. Stem pieces were dipped into Hormodin 2 powder and then placed into vermiculite in flats which were kept in a mist house until rooted. Cuttings have been the major source of experimental material since viable seeds are difficult to obtain. In the field root pieces from which the shoot and crown have been severed readily develop new shoots.

Lycium pallidum Miers. Stem pieces from the field failed to root. Cuttings from seedlings growing in the glasshouse have rooted under mist with Mormodin 2 or 3. Similar results were obtained with *Lycium shockleyi* Gray.

Franseria dumosa Gray. Stem pieces rooted easily from field or glasshouse. They were dipped in Hormodin 2 powder and placed in vermiculite in a mist house until rooted. Age of clone was not an important factor.

Atriplex canescens (Pursh) Nutt. Stem pieces from seedlings rooted readily. Growth regulator was not used for routine rooting, and use of an open glasshouse was most successful.

Atriplex confertifolia (Torr. & Frem.) Wats. Cuttings from seedlings or from plants in a juvenile form rooted most readily. No growth regulator was used, and the cuttings placed in an open glasshouse with bottom heat rooted readily. Good success was obtained for material placed in soil for rooting.

Atriplex hymenelytra (Torr.) Wats. Cuttings from young seedlings rooted readily under the same conditions as *A. confertifolia*. Somewhat better success has been obtained with cuttings placed in soil than with cuttings in vermiculite. The percentage of rooting seemed to decrease as stock seedlings became older, especially during winter months.

Atriplex lentiformis (Torr.) Wats. Cuttings rooted from a specimen brought into the glasshouse from the field and transplanted into soil. The most successful procedure involved dipping stem pieces in Hormodin 3 powder, placing them in soil (actually in individual cardboard containers for ease in handling), and putting in an open glasshouse until rooted. A large population of plants has been produced from the stock plant.

Eurotia lanata (Pursh) Moq. If vigorous new growing shoots were used, cuttings from old plants rooted as did those from younger seedlings. Use of a lathhouse with Hormodin 2 powder and vermiculite gave best results. Dormancy is a problem with this species in that it prefers a cold root temperature of about 20°C or less.

Grayia spinosa (Hook.) Moq. Some cuttings were made of material

brought from the field; but more success was obtained from material obtained from plants growing in the glasshouse or lathhouse and which had been chilled at about 4°C before cuttings were taken. Dipping stem pieces into Hormodin 2 powder and then placing them in vermiculite in a lathhouse resulted in most successful rooting. Mist also gave very satisfactory results. Good temperature is necessary for vegetative growth of this species.

Ephedra viridis Cov. Stem cuttings from seedlings rooted readily when they were placed in Yolo loam soil (individual cardboard containers) in the open glasshouse with bottom heat. There was no advantage to the IBA treatments. A few cuttings were made from pieces brought in from the field, but none survived after transplanting.

Thamnosma montana Torr. & Frem. Cuttings rooted readily, particularly when dipped with either of the Hormodin powders before being placed in vermiculite in the open glasshouse.

Kochia americana Wats. Cuttings from field-grown stem pieces have been made without IBA in a dry glasshouse and in soil. Only succulent material rooted.

The success so far obtained with vegetative propagation of these species is of interest for two major reasons. Clonal populations of the plants can be prepared for experimental studies for several of the species. Also the 3 $\times$ 5 experimental design may be used to test and prepare populations of other species which may be of ecological or economic interest.

The study of vegetative propagation of desert woody plant materials is being continued in that clonal populations are needed for many contemplated biological studies. It can be expected that the techniques described here will be improved and that some of the problems encountered will be solved and that other species will be rooted.

Conclusions

1. Stem cuttings of 14 woody desert perennial shrub species were successfully rooted. At least one of these, *L. divaricata,* is a species for which earlier attempts to root had been unsuccessful (Chase and Strain, 1966).

2. Conditions for successful rooting varied with species. *L. divaricata, A. hymenelytra, A. confertifolia,* and *C. ramosissima* rooted more readily in soil than in vermiculite. IBA was not needed for Atriplex species or *K. americana. L. divaricata, L. andersonii, F. dumosa, A. tridentata* and *G. spinosa* required mist or responded satisfactorily to mist rooting while other species disintegrated rapidly under the same circumstances. Other species rooted equally or better under dry conditions or even in a lathhouse where temperatures are lower. These include *G. spinosa, E. lanata, E. viridis* and *T. montana. E. viridis* responded to bottom heat.

3. The species studied for which stem cuttings have failed to root include *Krameria parvifolia* Benth., and *Juniperus osteosperma* (Torr.) Little.

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NOTES AND NEWS

Foxtail Pine on Sirretta Peak, California.—The distribution of the Foxtail Pine, *Pinus balfouriana* Grev. & Balf. in California is disjunct and confined to two high elevation areas about 300 miles apart. The northern population is in the Klamath Mountains of northwestern California from Lake Mountain (elev. 6,903 ft., 41° 44.9′N. latitude and 123° 7.9′W. longtitude) to South Yolla Bolly Mountains (elev. 8,092 ft.; 40° 2.2′N. latitude and 122° 51.2′W. longitude). The southern population is about 300 air miles south of the South Yolla Bolly Mountains in the southern Sierra Nevada (Critchfield, W. B., 1966. Geographic distribution of the pines of the world. U. S. D. A. Misc. Publ. 991). The northern extent of the southern population is uncertain, but specimens were collected by Peter Raven on the steep south wall of the South Fork of the Kings River about one mile north of Bench Lake (ca. 9,900 ft. at 36° 57.7′N. latitude and 118° 27.1′W. longitude). The southern-most known locality was considered previously to be Olancha Peak (elev. 12,135 ft.; 36° 15′54″ N. lat. and 118° 7′6″ W. longitude).

On August 13, 1967 we encountered foxtail pine on Sirretta Peak (elev. 9,977 ft.; 35° 55.4′ N. latitude and 118° 19.9′ W. longitude). Several specimens were collected and are presently at the herbarium of Humboldt State College, Arcata, California. The above locality is approximately nine miles north of the Tulare-Kern County line. This area was examined for the foxtail pine on the informaticn of its possible occurrence there from Victor Aubin of Kernville, California. Only the Sirretta Peak area and about two miles of the ridge that is oriented in a NW-SE direction were explored.

Ten trees were measured with both diameters and heights being taken. The largest tree measured 54.5 inches in diameter breast high, and 73 ft. in height. A few other tree measurements were as follows: 25.8 inches—53 ft., 28.3 inches—70 ft., 17.3 inches—49 ft., 5.9 inches—20 ft.

All the measured foxtail pines were at elevations ranging from about 8,970 to 9,780 ft., either on the west-facing slope or on the NW-SW ridge of Sirretta Peak.

Two other five-leaved pine associates were *Pinus flexilis* and *P. monticola*. Also present were two other pines, namely *P. jeffreyi* and *P. murrayana*. Another conifer present was *Abies magnifica* var. *shastensis*. The associated shrubs on the shallow decomposing granitic soils were *Castanopsis sempervirens, Arctostaphylos patula,* and *Spiraea* sp. Foxtail pine apparently was of higher density on north-facing slopes and extended to lower elevations on the west-facing slope of the ridge that was sampled.—H. Thomas Harvey, Department of Biological Sciences, San Jose State College, San Jose 95114, and Ronald J. Mastrogiuseppe, Arcata 95521.